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PATENT SPECIFICATION 988,258

DRAWINGS ATTACHED.

988,258

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COMPLETE SPECIFICATION.

Improvements in or relating to Bearings.

I, CHARLES SAMUEL WHITE, a citizen of the United States of America, of Palmdale, Los Angeles, California, United States of America, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to low friction bearings of the kind comprising a low friction organic polymer facing, a hard backing member, and a layer of hardenable material bonding the low friction material to the backing member and holding and conforming the low friction facing to a precise, predetermined shape, and to a method of making bearings of this kind.

In the production of bearings of the above kind it has been previously proposed to employ a laminated strip comprising two woven layers bonded together by a bondable material such as phenolformaldehyde one of the layers having threads of polytetrafluoroethylene which form the bearing surface and the other layer forming a thin backing for the bearing layer. In this prior proposal the hard backing layer is applied by injection moulding after the laminated strip has been formed into the required shape for the bearing, the thin backing layer preventing the hard backing member from penetrating to the bearing surface.

The method in accordance with the invention of making bearings of the kind referred to consists in first securing a strip of the low friction layer to a strip of the hard backing member to form a laminated strip and bending or shaping the laminated strip in one piece into its final form.

The low friction layer may be secured to the hard backing member by a bonding layer of thermo setting or thermo plastic material.

When the bearing is to be in the form of a bushing the laminated strip may be formed about a shaping mandrel so that the ends of thestrip abut against one another.

When the bearing is to be in the form of a liner for a ball joint the method may consist in forming the laminated strip around the ball, placing the ball with the strip thereon in a socket made in two parts which are subsequently welded together, heating the ball joint thus formed to soften the hardening layer and cause it to yield and accurately conform the low friction layer to the surface of the ball.

In the accompanying drawings:

Figure 1 is a broken plan view of a bearing in strip form embodying features of the present invention;

Fig. 2 is an enlarged sectional view of the structure illustrated in Fig. 1, taken along the line 2—2 thereof;

Fig. 3 is an enlarged sectional view, similar to that of Fig. 2, before a bonding layer and a low friction layer are added to the backing layer;

Fig. 4 is an enlarged sectional view, similar to that of Fig. 3, after the bonding layer has been applied to the backing layer;

Fig. 5 is a sectional view of a shaped mandrel having the strip bearing of Fig. 1 shaped to the surface thereof;

Fig. 6 is a sectional view of a sizing mandrel having the strip bearing of Fig. 1 encircling the surface thereof;

Fig. 7 is an enlarged sectional view, similar to that of Fig. 2, illustrating a modification of the invention;

Fig. 8 is a plan view, similar to that of

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Fig. 1, illustrating another modification of the invention;

Fig. 9 is a plan view of a control arm for an automotive vehicle having a ball joint embodying features of the present invention secured beneath the apex thereof;

Fig. 10 is a sectional view of the structure illustrated in Fig. 9, taken along the line 10—10 thereof;

Fig. 11 is a plan view of a strip bearing illustrating another form of the invention;

Referring to Figs. 1 and 2, a strip bearing 20 embodying features of the present invention is illustrated which comprises an elongated, relatively thin, backing layer 22 having a low friction layer 24 secured to one face thereof by a bonding layer 26. The backing layer 22 is preferably made of metal or other similar material which can provide a relatively rigid backing for the low friction layer and still enable the strip bearing 20 to be formed about a mandrel as illustrated in Fig. 5 and as will be described in greater detail hereinafter.

The low friction layer 24 can be any suitable low friction material which will provide a low friction face for the strip bearing 20 after it has been formed into a bushing or the like, as illustrated in Figs. 5 and 6. The bonding layer 26 can be any suitable plastic material that can bond the low friction layer 24 to the backing layer 22 and be softened under heat and pressure thereafter to accurately conform the low friction layer to the surface of one of the mandrels in Figs. 5 and 6, as will also be described in greater detail hereinafter.

Referring to Fig. 3, the backing layer 22 is illustrated before the layers 24 and 26 are bonded thereto. All four upper edges of the backing layer are rounded as indicated by the numerals 28, and the bonding layer 26 is bonded to the upper surface of the backing layer and extends over the rounded corners thereof, as illustrated in Fig. 4. The low friction layer 24 is thereafter bonded to the bonding layer 26 so that it also covers the rounded corners 28.

After the low friction layer 24 has been bonded to the bonding layer 26, the strip bearing can then be formed about a shaping mandrel 30, as illustrated in Fig. 5, to form the strip bearing into a bushing with the ends 32 of the strip bearing abutting against one another. If desired, the strip bearing can be made in one long strip which can be cut up into predetermined shorter lengths adapted to fit over the mandrel. Once the strip bearing is shaped about the mandrel 30, the metal backing layer 22 will retain the strip bearing in the shape of a bushing which can then be removed and disposed over a somewhat larger sizing mandrel 34, as illustrated in Fig. 6, with the ends 32 spaced slightly apart. Heat and pressure are then applied to the bushing to soften the bonding layer 26 until it yields to close the gap between the ends 32 and accurately conforms the low friction layer 24 to the exact diameter of the sizing mandrel 34.

The ends 32 are then preferably locked together by suitable means and the bonding layer 26 hardened so that the strip bearing will retain this final bushing shape having a very accurately sized internal diameter. The bushing is thereafter slipped off the end of the mandrel 34 and used for journaling shafts having the same diameter as the sizing mandrel 34. With this method, a large number of bushing-shaped strip bearings can be formed with mass production techniques which are each very accurately sized to an exact inside diameter. To obtain the desired diameter, the low friction layer 24 is preferably made relatively thin, a thickness of several thousandths of an inch being preferred. The bonding layer 26 need only be thick enough to provide the desired conformation and, of course, must soften at a lower temperature than the low friction layer and backing layer so that bonding layer provides the conformation and not the other layers. However, it is also within the purview of the invention to provide a bonding layer 26 that also has low friction properties, in which event the low friction layer could be eliminated with the bonding layer itself providing the low friction surface after it has conformed to the mandrel and hardened.

By rounding the corners 28 of the strip bearing as described above, the ends 32 can be abutted together in a more satisfactory manner when the bushing is finally sized and the rounded corners at the ends of the bushing enable the bushing to be freely slipped on and off the shaft which it is to support without damaging the ends of the low friction layer 24. If desired, the bonding layers 26 and low friction layer 24 can be carried completely around the corners 28 of the backing layer 22 as at 36 and 38, respectively, in Fig. 7 to cover all but the bottom surface of the backing layer 22 with the layer of low friction material 24.

As stated previously, the low friction layer 24 can be any low friction material which will provide a suitable bearing surface for the final bearing. Examples of suitable low friction materials are polytetrafluoroethylene resins, nylon, polyethylene molding compounds and monochlorotrifluoroethylene resins, the first and last resins being commonly referred to by the trade names Teflon (Registered Trade Mark) and Kel-F (registered Trade Mark), respectively. However, the preferred type of low friction layer comprises a thin layer of Teflon fibers either secured to the bonding layer 26 as a layer of flocking, felting or woven into a fabric layer, Teflon having far superior cold

flow characteristics when in fiber form than when in solid sheet form. Reference is made to White U.S. Patent 2,885,248 and British Patent Specification No. 845,547 for a detailed description of two ways of bonding Teflon fabric to the bonding layer 26.

As stated previously, the bonding layer 26 can be any theremosetting or thermoplastic material which will soften and yield at a lower temperature than the low friction layer 24 so that when heat and pressure are applied in the final sizing of the bushing, as described in connection with Fig. 6, the bonding layer 26 will yield to accurately conform the low friction layer 24 to the size of the mandrel, and can thereafter be hardened to retain the low friction layer in the final, accurate cylindrical shape. Suitable thermosetting resin materials are preferred for use as the bonding layer 26 since there are many thermosetting materials which are stronger and enable the completed bushing to support greater loads. Further, when a thermosetting resin material is used as the bonding layer 26, it can be partially polymerized or cured after bonding the low friction layer 24 to the backing layer 22, as illustrated in Fig. 4, to provide a strip bearing which can be stored idenfinitely in its hardened partially cured strip form. When it is desired to form the final bushing from the partially cured strip bearing, the strip bearing can be shaped as described in connection with Fig. 5, and finally sized under heat and pressure, as illustrated and described in connection with Fig. 6, the thermosetting bonding layer 26 softening under heat and pressure to conform the layer of low friction material accurately to the surface of the mandrel 34 before it is finally cured and hardens to rigidly retain the low friction layer in its exact final shape.

Referring to Fig. 8, a modification of the strip bearing 20 is illustrated wherein a circular tongue 40 is provided on one end of the strip bearing 20 and a corresponding groove 42 is provided in the other end thereof. When the bearing is finally sized about the sizing mandrel 34, the tongue 40 can be fitted within the groove 42 to interlock the ends 32 together and provide a smooth flush outer surface. In each of the embodiments described, the bushing is preferably used as a liner for the body or member which is to support the shaft and would preferably be secured within a suitable aperture in the body or member through which the shaft extends. Consequently, the ends 32 need not necessarily be locked together, but can be abutted together within the aperture (since they are abutted together when finally shaped about the sizing mandrel 34) and still retain their accurate internal diameter.

Referring to Figs. 9 and 10, a control arm 44 is illustrated having legs 46 on the inner end thereof adapted to be pivotally mounted on the frame of an automotive vehicle for supporting a front wheel of the vehicle. A ball joint 48 is secured to the underside of the pivoting end thereof and has a stud 49 adapted to be connected to the front wheel. A semispherical dome 50 is formed on the pivoting end of the control arm to provide the upper half of the socket for a ball 56 and a generally truncated stamping 52 having radially extending flanges 54 provides the lower half of the ball joint, the flanges 54 being welded or otherwise suitably secured to the underside of the control arm 44. The ball 56 of the ball joint is journaled within the socket by a bearing liner 58 which comprises the same three layers as the strip bearing 20, namely, the low friction layer 24, the bonding layer 26 and the backing layer 22. The bearing liner 58 is formed about the ball 56 in a manner somewhat similar to the way the strip bearing 20 was formed about the shaping mandrel of Fig. 5. The ball with the liner thereabout is then positioned within the socket between the dome 50 and the truncated spherical bottom stamping 52. The bearing liner is made slightly oversize so that the flanges 54 of the bottom stamping 52 do not quite meet the underside of the control arm. Heat is then applied to the ball joint to soften the bonding layer 26 and the flanges 54 are urged into abutting engagement with the control arm to exert radial pressure on the bearing liner 58 to cause the bonding layer 26 to yield and accurately conform the low friction layer 24 to the surface of the ball 56. After the bonding layer 26 is hardened, the low friction layer 24 is supported in position to intimately and accurately engage the surface of the ball to journal the ball in the socket. Normally, the greater friction between the backing layer 22 and socket will prevent the liner from shifting relative to the socket, but if desired, the liner can also be positively fixed against shifting relative to the socket by any suitable means, such as by welding, or by mechanically interlocking the liner and socket together.

Referring to Fig. 11, one way of forming the bearing liner 58 is illustrated. In this example, the bearing liner is first formed in a flat, star-shaped bearing 60 having a plurality of points or projections 62. The flat bearing 60, of course, comprises the same three layers as the bearing strip 20 and, as illustrated in Fig. 11, the backing layer 22 is on the upper side. The points 62 are proportioned so that the bearing 60 can be fitted over the dome of the ball and formed about the ball with the projections engaging the underside of the ball and nesting snugly together. Once formed over the ball in this manner, the ball with the liner thereon can be fitted between the dome 50 and stamping 52 and heat and pressure applied as previously

described to conform the low friction layer 24 accurately to the surface of the ball 56. If desired, the bonding layer 26 can be made from a thermosetting material and can be partially cured when the bearing 60 is in its flat shape as illustrated in Fig. 11, and finally cured after the bearing liner has been formed over the ball and the heat and pressure is applied. Also, if the low friction layer 24 comprises a fabric material it can be woven with an elastic or expansible weave to facilitate its formation about the dome of the ball 56.

WHAT WE CLAIM IS:—

1. The method of making a low friction bearing of the kind referred to consisting in first securing a strip of the low friction layer to a strip of the hard backing member to form a laminated strip and bending or shaping the laminated strip in one piece into its final form.

2. The method according to Claim 1 consisting in securing the low friction layer to the hard backing member by a bonding layer of thermosetting or thermoplastic material.

3. The method according to Claim 1 or 2 consisting in forming the laminated strip about a shaping mandrel to form the strip into a bushing with the ends of the strip abutting against one another.

4. The method according to Claim 3 consisting in removing the bushing from the mandrel and placing it on a larger sizing mandrel with the ends spaced slightly apart and applying heat and pressure to the bushing to soften the bonding layer until it yields to close the gap between the spaced ends of the bushing, thereby accurately conforming the low friction layer to the exact diameter of the sizing mandrel, and hardening the bonding layer.

5. The method according to Claim 4 consisting in locking together the ends of the bushing by engaging a tongue at one end of the laminated strip with a groove in the other end of the strip.

6. The method according to Claim 1 and 2 for making a bearing for a ball joint consisting in forming the laminated strip around the ball, placing the ball with the strip thereon in a socket made in two parts which are subsequently welded together, heating the ball joint thus formed to soften the bonding layer and cause it to yield and accurately conform the low friction layer to the surface of the ball.

7. The method according to Claim 6 in which the laminated strip fitted on the ball is of star shape.

8. The method according to any one of Claims 3 to 7 in which the low friction layer comprises a thin layer of fibres of polytetrafluoroethylene resins.

9. A bearing made according to the method claimed in any one of claims 1 to 8.

10. A bush bearing made according to any one of Claims 3 to 5 having rounded ends substantially as and for the purpose described.

11. The method of making a bearing of the kind referred to substantially as described herein with reference to the accompanying drawings.

12. A bearing of the kind referred to made substantially as described and as illustrated in the accompanying drawings.

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988258 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*